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*SOME CLIMATIC CONDITIONS OF OHIO.

OTTO E. JENNINGS.

Plant Ecology has to do with the adaptations and modifications of plants to each other and to the outside world. In taking up the study of plant ecology it is necessary, therefore, that factors external to the plant be taken into consideration. We must study the environment of the plant as well as the plant itself.

Probably a majority of the factors which make up the environment of plants and thus have to do with plant ecology fall within the domain of meteorology. Light, temperature, wind, and moisture (in its different forms) are all very important ecological factors and to their variations both singly and in combination are due most of the characteristic differences in the flora of different regions.

Practical workers along the different lines of plant production must keep within more or less definite limits determined by meteorological conditions. No farmer, orchardist, or gardener can well afford to ignore such things and much less can the ecologist, working more or less upon a theoretical basis, expect to accomplish much without taking into account these various meteorological factors.

In connection with Prof. Schaffner's work on the plant ecology of Ohio the writer has endeavored to work out the general

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meteorology of the state as far as it may have some part in the ecology of the region and it is the object of this paper to present the results of such investigations.

In view of the two very important requisites to trustworthy averages ;—(*a*) records running through a long period of years and (*b*) as uniform distribution over the State as possible, the following stations were selected as representing the meteorological conditions of Ohio: Ashtabula, Cleveland, Findlay, Montpelier, Sandusky, Toledo, Wooster, New Alexandria, Columbus, Milligan, Marietta, Portsmouth, Clarksville, Cincinnati, and Greenville.

These stations have records ranging in point of duration from six years at Ashtabula, eight years at Milligan, and ten years at Montpelier, on up to twenty-four years at Columbus and thirty-two years at Toledo, Cleveland, and Cincinnati. Although it is claimed generally by meteorologists that a longer record is necessary for accurate averages than is yet possessed by some of the stations named, it is believed, in view of the uniformity with which the stations having the shorter records have checked up with those having longer records, and in view of the fact that in cases of doubt records of neighboring stations were in several cases consulted, that very fair general averages have been obtained and that longer records will not materially alter our charts.

Precipitation, Total. (Plate III Map II.)

Taking up first the subject of precipitation we find no very great range in the normal annual amount. The valleys of the Ohio and Miami Rivers have the greatest precipitation, about forty inches per year, while the valley of the Maumee River has the least,—below thirty-five inches.

Snowfall. (Plate III Map I.)

Precipitation in the form of snow shows an entirely different set of averages from that of the total precipitation. The northern part of the state shows some very striking extremes. In less than one hundred miles along the shore of Lake Erie,—from Sandusky to Ashtabula,—the annual snowfall rises from thirty to sixty inches. South from Ashtabula the snowfall decreases to twenty inches in 150 miles, while a line drawn through the central part of the state from north to south would cover in 200 miles a range of but ten inches of snowfall.

Maximum Monthly Precipitation.

Another phase of the subject of precipitation which is of some importance ecologically is that of the maximum and minimum monthly precipitation. The records here again indicate very interesting differences in the state. Throughout the southwestern part of Ohio March is the wettest month of the year. The range was from 5.69 in. at Cincinnati to 9.02 in. at Portsmouth for the region having the maximum precipitation in March. With the exception of Milligan, with a maximum of 6.64 inches in June, the remainder of the state has its rainiest season in July with maxima ranging from 4.63 inches at Cleveland to 6.95 inches at Ashtabula.

Minimum Monthly Precipitation.

For the minimum monthly precipitation fourteen of the fifteen stations report October, the range being from 0.85 inches at Clarksville to 1.29 inches at Ashtabula. The one station not agreeing with the above was Sandusky with a minimum of 0.95 inches in December.

Rainy Days. (Plate III Map III.)

The region bordering Lake Erie, as might be suspected, leads the state in the total number of rainy (or snowy) days per year. Cleveland has precipitation 150 days in the year, while in the extreme northwestern and in the southeastern part of the state the number falls to below 100.

Clear Days Per Year. (Plate III Map IV.)

Sandusky reports the least number of clear days (69) while Ashtabula reports the greatest number,—over 160. Just why this should be is rather difficult to say. It was thought that perhaps some of the difference might be due to the shortness of record at Ashtabula (6 years) or to a lack of uniformity in sky observations at different stations, but the examination of the records of neighboring stations seemed to confirm the reliability of Ashtabula's records as averages of that locality.

Cloudy Days.

The number of cloudy days follows about the same order as the rainy days. A strip running south and west from Sandusky to Cincinnati through the central part of the state, includes the region having the greatest number of cloudy days. Sandusky leads with 169 per year.

The following table gives the above data in tabular form, complete for each station:

	Precipitation (inches).						Sky (No. days)		
	Total.	Max. Monthly.	Month.	Min. Monthly.	Month.	Snow.	Rainy.	Cloudy.	Clear.
Ashtabula	38.8	6.95	July	1.29	October	64.2	114	100	166
Cincinnati	38.5	5.69	March	.90	October	18.6	139	122	118
Clarksville	40.0	6.60	March	.85	October	18.5	133	118	149
Cleveland	36.5	4.63	July	1.06	October	38.8	159	139	102
Columbus	38.1	6.22	July	.81	October	20.3	149	131	104
Findlay	36.8	6.36	July	1.15	October	33.8	106	113	115
Greenville	38.4	6.27	March	.88	October	23.0	111	98	91
Marietta	42.6	6.14	July	1.12	October	17.6	121	132	97
Milligan	36.9	6.64	June	.87	October	26.3	99	76	121
Montpelier	37.3	6.14	July	.99	October	36.6	84	97	106
New Alexandria	43.1	6.19	July	1.11	October	26.6	96	135	132
Portsmouth	42.2	9.02	March	1.03	October	19.9	122	107	129
Sandusky	33.6	5.60	July	.95	December	26.9	140	169	69
Toledo	30.9	4.80	July	1.02	October	32.8	138	135	108
Wooster	37.9	6.08	July	.96	October	31.5	129	122	121

Mean Temperature. (Plate IV Map V.)

Taking up now the temperature of the state, we find a normal range of 6° F.,—from 49° F. in the extreme north to above 55° F. in the south. The annual isotherms vary quite regularly with the latitude excepting in the north-central part of the state as the map will show.

Extreme Maximum Temperature. (Plate IV Map VI.)

The highest temperature is normally reached in the latter part of July. The only station differing from this was Milligan with a maximum of 100° F. on August 11. The other fourteen stations ranged in extreme maxima from 100° at Portsmouth down to 92° at Greenville and 93° at Ashtabula.

Extreme Minimum Temperature. (Plate IV Map VII.)

The extreme minimum temperatures vary by twice as many degrees as do the extreme maximum. At Portsmouth the average of lowest records is one degree below zero, while Montpelier averages thirteen below and Milligan eighteen below zero. The time of the coldest averages is about January 24 at Columbus, this being the earliest, and February 7, at Ashtabula. As has been previously shown by Prof. Moseley in his "Sandusky Flora," ice drifting eastward in Lake Erie may prolong the cold season at points toward the eastern end of the Lake. This probably explains the lateness of the records of extremes at Ashta-

bula. The average for Milligan just given I think is probably too low. The records have been kept for only eight years and during this time has occurred the exceptionally low temperature of 1899 which must necessarily have unduly influenced the average. Yet it must be acknowledged that the region about Perry County and northwestward shows very low maxima; throwing out altogether its two lowest records, Milligan would still hold the lowest minima among the fifteen stations,—or, even leaving Milligan out altogether, the map will still remain practically unchanged.

Average Extreme Range of Tempeature.

(Plate IV Map VIII.)

By average extreme range of temperature is here meant the difference between the average of extreme minimum temperatures and the average of extreme maximum temperatures.

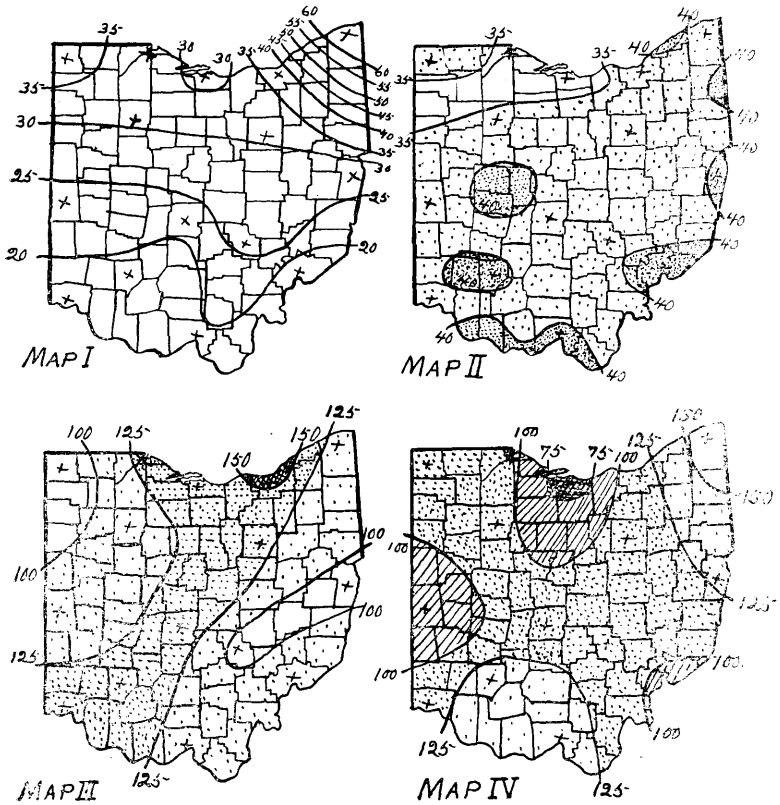
Considered thus the smallest range (The most equable temperature) is to be found along the shore of Lake Erie and in the immediate vicinity of the Ohio River, while the region of greatest extremes occurs in a strip commencing at the northwest corner of the state and continuing southeastward reaching its culminating point in Perry County, not more than fifty miles from the Ohio River, where the range is as small as anywhere in the state,—(Milligan 115° range and Marietta 100°).

The greatest ranges among the fifteen stations for any individual year were, as far as the records showed, at Milligan in 1899, 140° F. (39° to 101°) and at Findlay the same winter, 121° F. (22° to 99°).

Temperature Tables.

	Length of Record. Years.	Av'ge Maximum. (Extremes.) Degrees Fahr.	Date.	Av'ge Minimum. (Extremes.) Degrees Fahr.	Date.	Average Range Between Extremes.	Greatest Range Recorded in any One Year. Degrees Fahr.	Year.
Ashtabula	5	93	July 20	— 7	Feb. 7	100° Fahr.	105° Fahr.	1899
Cincinna i	31	97	July 22	— 3	Jan. 27	100 "	116 "	1899
Clarksville	13	97	July 29	— 6	Jan. 27	103 "	121 "	1899
Cleveland	31	94	July 24	— 6	Jan. 31	100 "	112 "	1897
Columbus	23	97	July 25	— 6	Jan. 24	113 "	118 "	1899
Findlay	10	99	July 28	—10	Jan. 28	109 "	121 "	1897
Greenville	13	92	July 31	— 9	Jan 31	101 "	111 "	1899 1901
Marietta	18	95	July 31	— 4	Jan. 27	99 "	116 "	1899
Milligan	7	100	Aug. 11	—18	Jan. 27	118 "	140 "	1899
Montpelier	9	96	July 23	—13	Jan. 28	109 "	118 "	1892 1897
New Alexandria	15	95	July 21	— 6	Feb. 1	101 "	116 "	1899
Portsmouth	15	100	July 9	— 1	Feb 4	101 "	119 "	1899
Sandusky	24	96	July 18	— 5	Feb. 2	101 "	115 "	1897
Toledo	31	95	July 21	— 6	Jan. 27	101 "	114 "	1897
Wooster	16	95	July 27	— 9	Jan. 28	104 "	118 "	1892

OHIO NATURALIST. *Plate 3.*



JENNINGS on "Some Climatic Conditions of Ohio."

EXPLANATION OF MAPS.

MAP I. Mean Annual Snowfall, in inches of snow.

MAP II. Mean Annual Precipitation, in inches.

The blank space denotes areas of less than 35 inches of precipitation, the medium dotted 35 to 40 inches, and the heavy dotted over 40 inches.

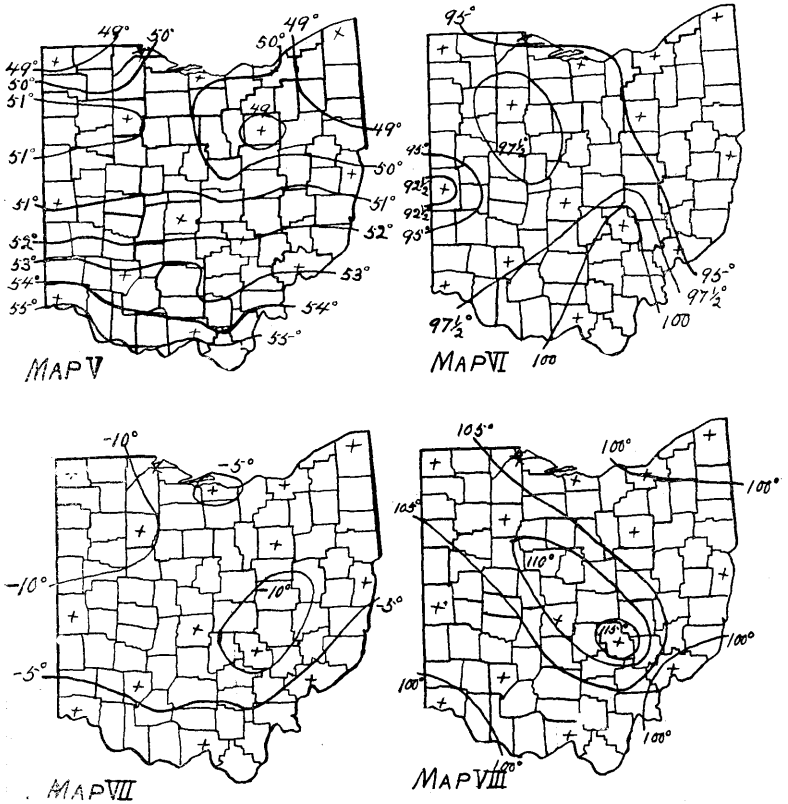
MAP III. Average Number of Days per year in which Precipitation Occurs.

The blank space represents areas of less than 100 days and the successively darker areas respectively, 100 to 125, 125 to 150, and the darkest 150 or more days.

MAP IV. Average Number of Clear Days per year.

The clear days increase from darkest area, less than 75, through the successively lighter portions up to 150 or more in the blank space.

OHIO NATURALIST. *Plate 4.*



JENNINGS on "Some Climatic Conditions of Ohio."

EXPLANATION OF MAPS.

MAP V. Mean Annual Temperature.

Lines denote mean temperature for the year ranging from 49 to 55 degrees Fahrenheit.

MAP VI. Mean Maximum Temperature.

Lines pass through points having the same average of maximum temperatures. Lines differ from each other by 2½ degrees Fahrenheit.

MAP VII. Mean Minimum Temperature.

Lines pass through points having the same average of extreme minimum temperature. The lines differ from each other by five degrees Fahrenheit.

MAP VIII. Mean Annual Range of Temperature.

Lines pass through points having the same average range between the extreme minimum and extreme maximum temperature of the year.